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Working Paper No. 17

Commercializing dairy and forage systems in Ethiopia: An innovation systems perspective

Improving Productivity and Market Success of Ethiopian Farmers

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Editing, design and layout—ILRI Publication Unit, Addis Ababa, Ethiopia.

Correct citation: Tesfaye Lemma Tefera, Puskur R, Hoekstra D and Azage Tegegne. 2010. *Commercializing dairy and forage systems in Ethiopia: An innovation systems perspective*. Working Paper 17. ILRI (International Livestock Research Institute), Nairobi, Kenya. 57 pp.

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Acknowledgements

We are grateful to the research assistants, Anteneh Girma, Dessalegn Molla, Kebede Manjur and Rahmeto Negash, for their hard work and inputs. We thank Dr Seife Ayele for reading the manuscript and providing invaluable comments. Last, but not least, we are grateful to key informants from the farming communities, and managers and staff of GOs and NGOs who patiently responded to our questions and openly shared their thoughts with us.

Abstract

This paper presents and discusses the results of the analysis of Ethiopian dairy and forage innovation systems. Two factors triggered the need for understanding the innovation systems: Ethiopian dairy subsector has not been able to take-off despite decades of research and development efforts; and the context for the subsector development is changing. The purpose of the research was to identify organizational, institutional and policy options to facilitate market-driven and knowledge-based smallholder dairy development in the country. Specifically, the analysis looked at contextual factors determining opportunities and necessities for innovation; the key innovation systems actors, pattern of interaction between them; coordination mechanisms; and the subsector development policy and strategy. The investigation was based on a survey of actors and their roles and interactions, review of policy, and project documents and available empirical evidence. The research identified constraints and challenges relating to market, supportive services, interaction of actors, inter-organizational coordination, and gaps in the subsector development policy and strategy. Finally, options are identified that can enhance commercialization and innovation. The options include: strengthening dairy cooperatives with emphasis on their business-orientation, linking them, where appropriate, vertically to processors and input suppliers, and strategically linking dairy development intervention to informal markets through food security/food transfer programs and institutionalized school feeding programs; public support for the development of private service and pluralistic service delivery system, alongside strengthening public capacity for performing regulatory and quality assurance functions effectively; formulating national dairy development policy and strategy to ensure coordinated policy implementation on the ground; encouraging the integration of emerging dairy cooperatives at higher levels and capacity building to enable them to demand service, command accountability, and serve as a mouthpiece of producers; capitalizing on the on-going Business Process Re-engineering for revising the prevailing reward systems in public research and extension to encourage innovation and impact-orientation; creating incentive system such as leverage fund and competitive grant to encourage intervention-based public–private innovation partnership; and strengthening dairy platform at *woreda* and/or milkshed level for achieving of better impact through continuous incremental improvements and to facilitate scaling out and up of successful experience to achieve wider impact and inform higher policymaking.

1 Introduction

At least two sets of factors underlie the need for understanding the Ethiopian dairy and fodder innovation systems (DFIS) and its role in improving productivity and market orientation of smallholder dairy production. First, empirical evidence shows that Ethiopian dairy subsector has not been able to take-off despite decades of research and development (R&D) efforts (Ahmed et al. 2004; Staal et al. 2008). Secondly, the national agenda and aspirations for agriculture and rural development (economic growth, poverty alleviation and ecological sustainability), resource-base (land, water and feed), market demand (reliability of supply, quality and safety) and the number and diversity of actors (public, private and civil societies) involved in the dairy subsector are changing.

Innovation, i.e. the productive use of knowledge for positive economic and social outcomes, is crucial in Ethiopian dairy subsector to circumvent the increasing natural resource scarcity, to increase productivity to generate marketable surplus, to improve market competitiveness of smallholder producers, and to adapt and respond to dynamic opportunities and challenges. Innovation emerges where market incentive exists and economic agents are willing and able to take risk; where appropriate institutional arrangements exist to reduce transaction costs of exchanges—knowledge or otherwise; and where adaptive innovation policies and enforcement mechanisms are in place (Hidalgo and Albors 2008). Innovation capacity depends on the ability of producers, entrepreneurs and support services to interact with each other and with other actors to access and creatively use knowledge of different kinds for practical problem-solving (Altenburg et al. 2008). And well-functioning innovation systems depend on the strength of collective capacity for mutual learning, which, in turn, calls for effective mechanisms for mobilizing inputs and coordinating efforts in the sector (Engel 1997).

This paper reports on analysis of Ethiopian dairy and forage innovation systems conducted with specific objectives of: (a) understanding the contextual factors determining opportunities and necessities for commercialization and innovation; (b) identifying key actors and their respective roles; (c) exploring incentives, habits and practices influencing pattern of inter-organizational interaction; (d) assessing coordination status and coordination mechanisms; and (e) understanding policy and strategies for dairy development. The investigation is intended to help (a) identify organizational and institutional options for addressing factors constraining market-driven and knowledge-based smallholder dairy development, also drawing on relevant successful experience elsewhere in Asia and Africa, (b) identify entry points for enhancing capacities and skills of different actors for learning and innovation, and (c) highlight enabling conditions necessary for enhancing innovation in Ethiopian dairy systems.

The paper is organized in six sections. The next section provides the background and highlights the challenges faced by Ethiopian smallholder dairy subsector. Section Three presents a brief discussion of the innovation systems perspective, followed by the methodology employed in this study. Section Four elucidates the context within which Ethiopian DFIS is embedded. The findings of the study are presented and discussed in Section Five. Section Six draws conclusions and recommends organizational, institutional and policy options for enhancing commercialization and innovation in the smallholder dairy systems.

2 Background and rationale

Market-oriented development of smallholder dairy in developing economies is an important pathway out of rural poverty and it could be a powerful tool for sustainable rural livelihood improvement (Bennett et al. 2006). Ethiopia has a huge untapped potential for market-oriented development of smallholder dairy production. The population of genetically diverse milking cows in the country is estimated at 9.9 million heads (CSA 2008). The agro-ecology, particularly of the Ethiopian highland mixed crop–livestock systems, is considered conducive and relatively disease-free to support crossbred dairy cattle (Ahmed et al. 2004). The following subsections provide an overview of dairy development efforts in Ethiopia, paying special attention to the focus of the interventions, achievements, lessons, and emerging challenges.

2.1 Dairy development efforts in Ethiopia: Focus and achievements

Formal R&D efforts for dairy development began in the late 1940s (Feleke 2003) and continued, mainly through donor-financed dairy and livestock development projects. A close scrutiny of different project, policy and research documents revealed that they were mainly supply-driven initiatives, emphasizing the transfer of technology and public provision of inputs and services. The focus was on breed, feed, and animal health service improvement; promotion of milk processing and formal marketing (large- and small-scale); infrastructure development; and capacity building for technology generation and transfer. However, the dairy subsector has not been able to take-off despite over six decades of R&D efforts.

The total milk production from about 10 million milking cows is estimated at about 3.2 billion litres, an average of 1.54 litres per cow per day over a lactation period of about 6 months (CSA 2008). The performance of Ethiopian dairy subsector has been lagging far behind that of the neighbouring countries with comparable agro-ecological conditions (Table 1). The national milk production had increased by 1.6% and per capita production declined by about 0.8% annually during 1966–2001 (Staal et al. 2008). The authors conclude that 'the development efforts had little impact on the growth of the sector as a whole, even in the areas where they were implemented.'

Table 1. *Milk production and yields for Ethiopia, Kenya and Sudan*

	Ethiopia	Kenya	Sudan
Feed supplied to livestock (kg of maize equivalent per animal)	28	40	94
Annual R&D investment in agriculture per hectare (USD)	7	27	8
Yield (litres/milking animal)/lactation	208	498	480
Annual growth rate of milk production from 1970–1999 (%)	2.36	3.60	4.79
Domestic consumption of milk (t)	893,699	2,212,323	2,753,129

Source: Compiled from Staal et al. (2008).

Only 0.15% of rural livestock holders reported on-farm production of improved forages like alfalfa and Napier grass; the use of industrial by-products like oil cake, bran, and brewery residue was negligible (0.8%); the population of exotic and crossbred dairy cows in rural areas of the country accounted for less than 1% of the total dairy cattle population; and the blood levels of the limited crossbred population were unknown, due to the lack of appropriate breed registration system (CSA 2008). Other empirical evidences (Ahmed et al. 2004; Azage et al. 2006; CSA 2008; Staal et al. 2008) showed that the generic supply-side constraints (feed, breed, animal health etc.) have not yet been resolved; the coverage and quality of support services need significant improvement; private provision of services is underdeveloped, and pluralistic service provision is in 'disarray' due to limited or no coordination.

2.2 Lessons and challenges

Overcoming the supply-side constraints related to feeding, breeding and animal health was, and still is, crucial to achieving productivity growth in Ethiopian dairy subsector. Nevertheless, it has long been recognized that technological change should go hand in hand with institutional change to be successful (Leeuwis 2004; Pérez 1989 cited in Altenburg et al. 2008). Although knowledge about technology and production are necessary, they are not sufficient to improve productivity and enhance market-orientation of smallholder dairy. Market-driven innovations to succeed often require commensurate organizational/managerial and institutional changes, and changes in policy. For instance, a study by Ahmed et al. (2004) showed that the rate of adoption of fodder and pasture land management technologies in Ethiopia was extremely low for several reasons, which include factors relating to institution, economic incentives, support service delivery and policy. These complementarities between technical and non-technical changes had not been understood or well appreciated in the previous interventions for dairy development in the country.

Market-orientation of the production systems and the possibility of exporting Ethiopian dairy products were limited by high transaction costs despite low costs of production (Ahmed et al. 2004). Development of vertically integrated and coordinated milk value chain is an important option to reduce operational and transaction costs, to meet consumers demand and to encourage partnerships along the chain (Costales et al. 2006). There is a serious concern, however, that smallholder agricultural producers are often excluded from participation in value chain since they usually lack access to credit, make limited investment in their human capital (including skills and entrepreneurship training), and are isolated by physical distance from the market (Mendoza and Thelen 2008).

On the other hand, the development of sustainable milk value chain equally depends on the existence of a vibrant private sector capable of providing the essential input and support services, which include manufacturing of small-scale processing equipment, processing and distribution of milk and products. This implies, in addition to the creation of enabling policies, laws and regulatory environment for private service delivery, public support for private service development is vital. This is because often market alone fails to allocate resources such as capital, skills and technological development to private sector and to ensure effective coordination within a sector (Kurokawa et al. 2008).

Hence, ensuring effective coordination and tailoring investment and intervention strategies for location specificity are challenging, but critical.

3 Research framework and methods

3.1 Innovation systems framework

The research design, data collection and analysis for the current study have been informed by the innovation systems framework. This section provides a working definition of innovation and briefly explains pertinent issues and concepts underpinning the innovation systems perspective.

The literature provides several definitions of innovation (Engle 1997; Biggs 1989; Spielman 2006; World Bank 2006; Hidalgo and Albors 2008). The operational definition used in this paper is 'innovation is the process of successful use of knowledge, originating from various sources and acquired by various mechanisms for practical problem-solving'. Innovation can result from the application of not only new knowledge, but also from creative use of accumulated knowledge. Hall (2006) contended that it would be possible to significantly improve productivity and efficiency of smallholder livestock sector in developing countries through creative use of the already existing low-cost technology, established tools, and through new ways of thinking about problems and doing business.

The networks of public and non-public actors engaged in the social processes of generation, acquisition, exchange, adaptation, and use of agricultural knowledge; together with the institutions and policies that affect their behaviour and performance constitute agricultural innovation systems (Hall et al. 2006). In other words, an innovation system could be seen as a set of knowledge intensive interactive relationships among the actors to turn an idea into a process, product or service for the market.[1]

Several factors can trigger innovation. Deliberate effort to innovate can stem from a wish to seize opportunities and/or it can represent a response to challenges relating to changing market, natural resource base, technology, policy and institutions. Unlike the Green Revolution in crop production, which was primarily supply-driven, the expected 'Livestock Revolution' in developing economies would be demand-driven (Delgado et al. 1999, 2002).

Innovation is an interactive learning process, which often requires the integration of ideas, knowledge, experience and creativity from multiple actors through networking, linkage creation and partnerships (Leeuwis 2004). It is a social process involving learning-by-using, learning-by-doing or learning-by-sharing, both internally and externally (Hidalgo and Albors 2008). Innovative capacity within a sector thus depends on the quality and density of interactive relationships between producers, enterprise (market) and support

1. http://www.idrc.ca/gender_and_innovation/.

services. The latter include public and private organizations which carry out research, train, advice, finance, coordinate and regulate (Altenburg et al. 2008). The existence, intensity and nature of interactions between actors are conditioned by institutions,[2] which can either encourage or discourage learning, interacting and knowledge sharing, both within and between organizations (Hall 2006).

In a multi-stakeholder context, the process of experiential social learning often requires piloted joint innovation activities, participatory process and impact monitoring, documentation and learning. In particular, a strategy should be developed in such a way that the social and organizational process that has brought out desirable economic, social and environmental impacts would be replicated—scaled out and up.[3]

Whilst acknowledging the importance of the creation of knowledge and technology, the innovation systems concept extends to encompass the factors affecting demand for knowledge, access to knowledge and the use of knowledge in economically and socially useful ways (Rajalahti et al. 2008). The significance of enhancing skills and developing appropriate support systems for institutional coordination, management and organization, marketing, financing, technology and smallholder farmers collective action and networking support cannot be discounted. Innovation systems thinking acknowledge explicitly the importance of institutions and the wider policy environment.

In addition, coordinating the inputs (knowledge, financial resources, social capital and political capital) of various actors and their expectations in a way that enables, rather than impairs, innovation is critical. Yet, there is no one best way of achieving effective coordination; and they are highly context specific. Literature recommends a process-driven approach (Engel 1997) where actors make mutual adjustments to coordination mechanisms as they go through experiential social learning. Hence, innovation process entails creating and managing linkages for alignment of actors and this might require brokering agents: a 'lead operator'—who organizes and manages networks; and a 'caretaker'—who maintains the integrity of the network (Klerkx and Leeuwis 2007). This becomes particularly challenging when we are dealing with the rather unstructured and informal smallholder dairy subsector.

The wider policy environment matters. National policies can promote creativity and innovation by providing incentives, resources and support structures (Hall et al. 2006). Ensuring effective coordination of policies, including crop–livestock interaction, and

2. Institutions are formal and informal routines, procedures and behaviours (OECD 2005) and, are not synonymous with organizations.

3. 'Scaling out' is the spread of innovations—technological or otherwise—within the same stakeholders group, whereas 'scaling-up' is a vertical institutional expansion of innovations—from grassroots to policymakers, donors, other stakeholders (Douthwaite et al. 2003).

context specific and adaptive process of policymaking, informed by impact and process monitoring, are equally important to optimize impacts (Mytelka 2007). This has important behavioural implications. It means, firstly, that policymakers and administrators ought to be engaged in debate, vision development and decision-making as partners, along with other actors (Alsop and Farrington 1998). Secondly, policy capacity for effective facilitation of participatory and adaptive policymaking needs to be strengthened.

3.2 Data sources and collection methods

Improving Productivity and Market Success (IPMS) project of Ethiopian farmers, being implemented by ILRI on behalf of the MoARD, has the objective of developing and testing strategies for enhancing market orientation of smallholder farming. Smallholder dairy has been selected as one of priority commodities for market-oriented development in 8 of the 10 (see map in Annex 1) pilot learning *woredas* (PLWs); and feed scarcity is the biggest challenge for livestock development across the PLWs.

The research has been undertaken in three phases: survey of DFIS actors, community-level qualitative study, and stakeholders' workshop. The current paper presents interim findings from the first phase, focusing on fluid milk system of urban, peri-urban and some pastoral areas. The community level qualitative research will look into both fluid milk and butter systems.

The first phase included interviews with key actors, and an extensive review of project and policy documents and relevant empirical research. The review provided important insights, particularly historical perspectives on dairy and forage development in Ethiopia. A review of successful smallholder dairy development experiences in selected Asian and African countries was undertaken to learn how other countries had dealt with similar challenges.

The fieldwork was conducted during October–November 2007 both at regional and *woreda* (district) levels, with a focus on the latter. It covered eight PLWs, viz, Fogera and Bure (Amhara Region), Ada'a Liben and Miesso (Oromia Region), Alaba and Dale (SNNPR) and Alamata and Atsbi-Wemberta (Tigray Region).

The key actors (individuals, groups and organizations) in the PLWs and corresponding regions had been identified on the basis of information available from various sources and literature. In addition, additional actors were identified during the fieldwork through 'snowballing'. Diverse actors[4] from public, private and civil societies were interviewed in all PLWs, and these included:

4. Most of the actors are those engaged mainly in urban and peri-urban fluid milk systems. Some attempt was made to learn about rural butter system from livestock researchers and experts of WoARD.

- livestock, marketing, inputs, cooperative main departments/agencies of Regional Bureaus of Agriculture and Rural Development (RBARD), and *Woreda* Offices of Agriculture and Rural Development (WoARD)[5] in the eight PLWs,
- livestock directorates at Regional Agricultural Research Institutes (RARIs), six agricultural research centres, a college of agriculture and an academic department with animal sciences stream,
- eight national and international NGOs,
- eight rural financial organizations,
- ten dairy cooperatives and an informal women's milk group in Miesso PLW,
- three projects (IPMS and two dairy development),
- private actors comprising input suppliers (concentrate feed producers and retailers, industries selling by-products as dairy feeds), breeding and animal health service providers (owners of veterinary clinic, veterinary pharmacy, paravets, community animal health workers), and
- dairy products consumers (hotels, restaurants and cafes).

The primary method employed for collecting the needed data was a series of semi-structured interviews with relevant actors using pre-tested checklists. The checklists were designed to perceptions of context and trends; actors and their roles; patterns of interactions between actors; incentives, habits and practices conditioning interactions; coordination status and mechanisms; and actors' perceptions of the influence of the wider policy. Interviews were conducted with management teams and expert groups separately in large public organizations; and dairy cooperative leaders and members were interviewed separately. Group interviews (management and staff together) and individual interviews were conducted, respectively, with smaller organizations and individual actors.

3.3 Analysis

Context and trend analysis, linkage analysis, and partnership and coordination analysis were carried out. Particularly, participatory linkage mapping and analysis was instrumental for understanding pattern of interactions; and the roles of incentive, habits and practices. Eliciting views of actors on alternative courses of action to enhancing innovation system performance was the integral part of the participatory exercise.

Qualitative information was systematically categorized, tabulated and summarized for each PLW. PLW-level observations were analysed and synthesised by identifying patterns and ascertaining the extent to which the identified patterns were featured across PLWs. Relevant findings from previous qualitative research by IPMS and others were used to fill some gaps in the dataset. Data from various sources coupled with plausible theoretical

5. *Woreda* office of pastoralist development in Miesso.

arguments helped in identifying organizational, institutional and policy options for enhanced innovation capacity in the Ethiopian dairy systems.

4 Context for smallholder dairy development

This section provides an overview of the context within which Ethiopian DFIS is embedded, and trends in the contextual factors such as market, feed resource-base, and the wider policy environment. These contextual factors determine opportunities and necessities for innovations and commercialization of smallholder dairy systems. A description of changing context would also reveal possible mismatches between changing demand for innovation, innovation systems and practices (Rajalahti et al. 2008).

4.1 Overview of dairy production systems in Ethiopia

Dairy production systems in the country are usually categorized based on location (Staal et al. 2008) into four, viz, urban, peri-urban, rural and pastoral systems. The urban dairy system could be classified further into at least two subsystems, viz, large-scale private commercial farms and small-scale family farms. Another way of classifying the dairy production systems is on the basis of the main product supplied to the market, viz, fluid milk system and butter system. Dairy production in urban, peri-urban and some pastoral areas (e.g. Miesso) are fluid milk systems, whereas rural dairy production in the Ethiopian highlands is mostly a butter system.

Discussion was held with expert groups, particularly livestock researchers and experts at WoARD, to learn about diversity of the dairy production systems and their implications (Table 2). The peri-urban dairy system, like that of urban, has a comparative advantage in fluid milk supply due to its proximity to market in comparison to the rural dairy system, which mainly supplies butter to the market. The number and heterogeneity of actors engaged in smallholder dairy development is also different across PLWs.

Location-specific factors determine disease incidence and outbreak (Gerber et al 2008); and socio-economic criteria are as important to the success of interventions as natural and technical requirements (Ouma et al. 2007). The probability of adoption of dairy technologies is influenced by many factors such as agro-climate, market access, cattle density and other household specific factors. Case studies carried out in several Asian countries such as Bangladesh, Mongolia, the Philippines and Vietnam underline the importance of careful spatial and social targeting of smallholder dairy development interventions (FAO 2007). The diversity demands customizing policy and development interventions that are location specific. Experience shows that investment and dairy development interventions can be systematically targeted through, among others, observations from household survey and GIS (Ouma et al. 2007; Gerber et al. 2008).

Table 2. *Essential features of rural and urban dairy systems in Ethiopia (based on opinions of experts, dairy cooperative leaders and members)*[6]

Features	Urban (small-scale)	Rural
Contribution to income	Supplements non-farm income, partially a business enterprise	Supplements farm income, often not considered as a business enterprise
Market orientation	Relatively higher	Low, only surplus sold
Market transactions	Partially informal	Primarily informal
Main product marketed	Milk	Butter
Cattle breeds	Partially crossbred	Local zebu
Source of labour	Mainly family, but also hired labour	Family
Source of feed	Purchased fodder, crop residues and feed, households wastes, backyard fodder	Natural pasture, crop residues
Involvement of women along value chain and control of benefits	Moderate to low	High to moderate
Source of knowledge	Public and private sector actors	Mainly public sector actors
Feed constraints	Increasing fodder and feed prices	Dwindling communal grazing land size and quality
Land related constraints	Competition from alternative non-farm land uses	Competition from crop production
Environment related issue	Waste management, pollution etc.	Invasive weeds, deforestation, soil compaction
Social context	Socially and economically highly heterogeneous producers	Socially and economically less heterogeneous producers
Literacy level of producers	Moderate	Low
Institutional constraints	Insecure land use rights; land use for agriculture is highly contested	Relatively secure land use rights; land use for agriculture less contested and seen as legitimate

Source: Field study.

4.2 Market

Markets, not production, increasingly drive agricultural development (Rajalahti et al. 2008), particularly livestock development (Delgado et al. 1999). Recent empirical evidence confirms Ethiopian dairy subsector development has primarily been conditioned by demand-side factors, more than the availability of technological options to overcome the supply-side constraints such as feeding, breeding and animal health (Staal et al. 2008).

In Ethiopia, the national per capita consumption of milk and milk products is about 17 kg, which is one of the lowest in sub-Saharan Africa, due to economic and cultural

6. The results presented in this paper are based on data collected from the survey, unless otherwise indicated.

reasons (Ahmed et al. 2004). The average expenditure on milk and products by Ethiopian households accounts for only 4% of the total household food budget (Staal et al. 2008). The habit of consuming milk and milk products is yet to be developed, even among middle income urban households with a better purchasing power. The small quantity of milk produced coupled with high transaction cost results in lower prices for smallholder unorganized producers, and high product price for poor urban consumers leading to low effective demand.

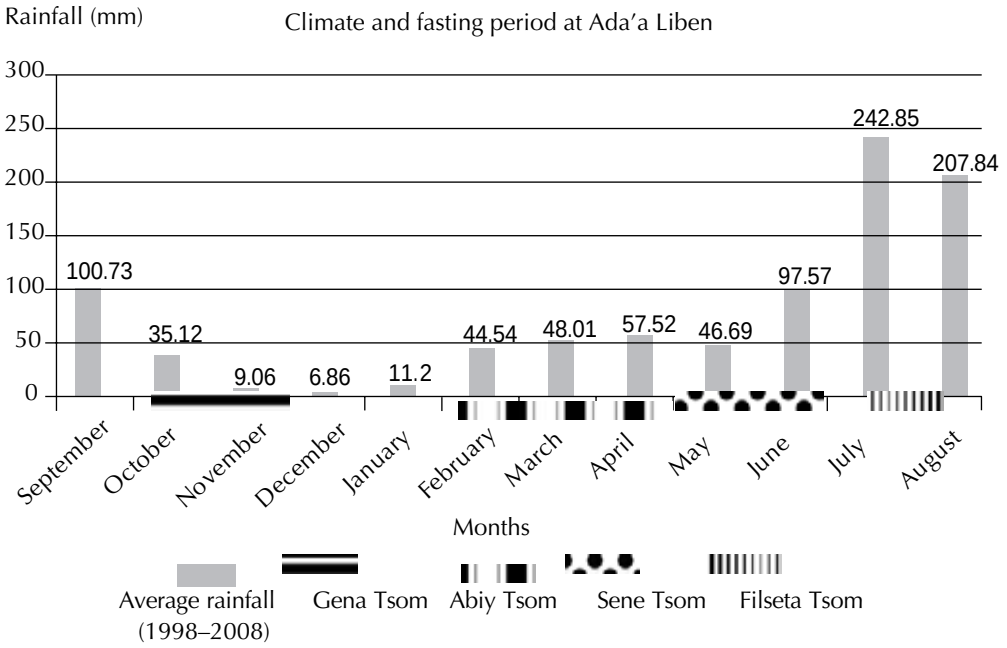
The demand for milk and products appears to be rising, though, in the recent years. It was consistently reported across regions and PLWs that the demand, supply and price trends for milk and products (butter) have been increasing over the last five years (Table 2). While the perceived contributing factors such as increased urbanization and population growth are similar across PLWs, others like the establishment of new processing plants (Amhara region) and increased number of dairy enterprises (Hawassa in SNNP, and Adigrat and Mekele in Tigray regions) are region or PLW specific. A limited number of respondents (producers, researchers, experts etc.) had mentioned increasing productivity as factor leading to increased milk and butter supply. Urban and peri-urban producers held different views on whether increasing demand or increasing cost of production was more responsible for higher product prices (Table 3).

Table 3. *Perceptions of demand, supply and price trends for milk and milk products in urban and peri-urban systems*

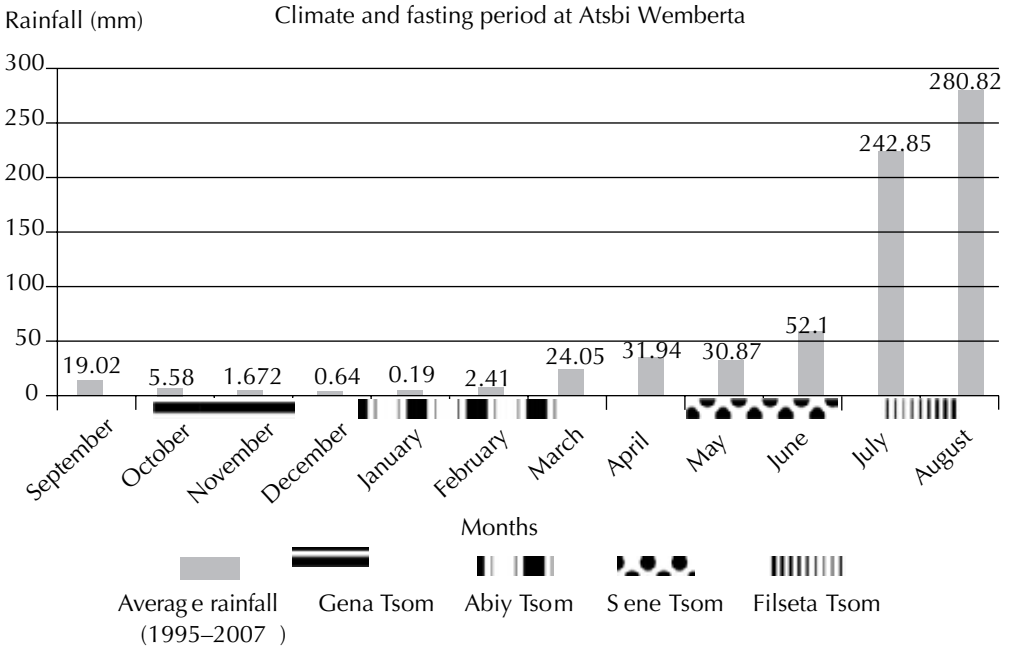
Trends	Drivers
Increasing demand for raw milk and butter	Increasing urbanization and population growth
	New market outlets due to improved road condition
	New market outlets due to establishment of processing plants, super-market selling local products
Increasing market supply of milk	Reduced transaction costs due to better road and collective marketing
	Changing attitudes of producers towards selling of milk
	New entrants to the enterprise in urban/peri-urban areas
	Modest productivity growth, particularly in urban/peri-urban areas
Increasing prices of raw milk and butter	Increasing demand
	Increasing production costs, particularly feeds
Increasing price of fod-der and feeds (urban)	Increasing fodder and feed scarcity
Limited extent of quality improvements	Quality control by cooperatives, with external technical and material support
Diversified products	Processing cooperatives, with external technical and material support

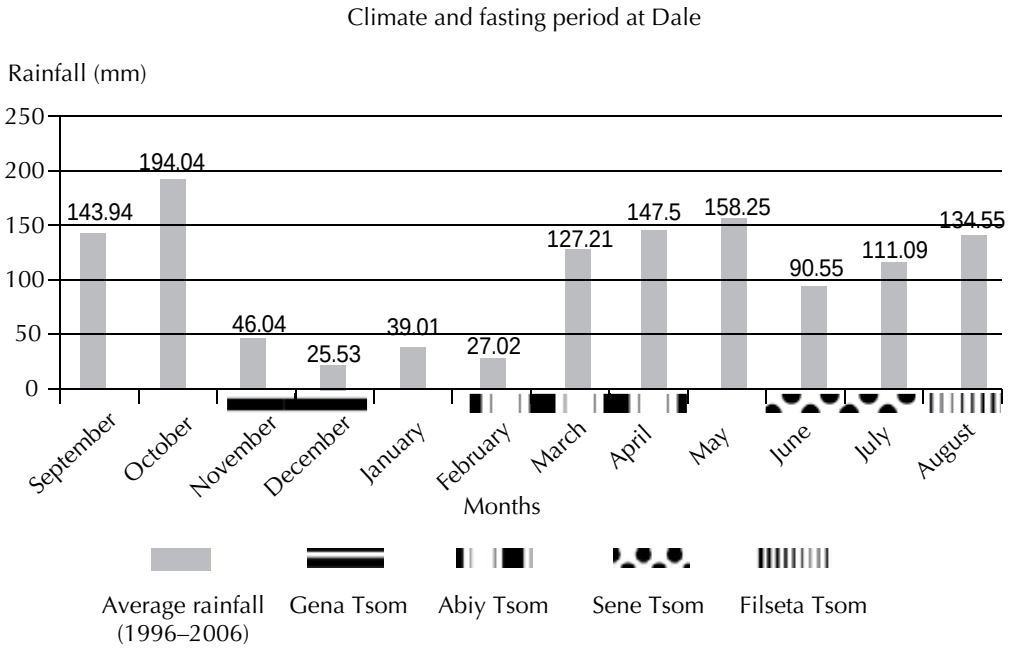
The highly seasonal demand for and supply of dairy products is widely perceived as an important problem. The Orthodox Christians refrain from consuming dairy products during fasting periods, which amount to about 200 days per annum. Consumers

complained about product shortfall during the dry season, whereas producers and dairy cooperatives are concerned about the low product prices and demand during Christian fasting periods. Figure 1 juxtaposes intra-annual average rainfall with the fasting periods. In Ada'a Liben which could be categorized as an urban system, the fasting periods coincide with the high rainfall seasons where the feed availability and therefore, the milk production are high. Similar is the case with Atsbi-Wemberta which is a remote rural system. Butter, therefore, becomes the obvious product choice for the market. The demand and supply balance is expected to be relatively more stable in Dale with an even spread of annual rainfall, which is a peri-urban system close to a rapidly growing city. However, it has to be noted that this trend depends on the numbers and proportion of Orthodox Christians and population from other religions. Dairy cooperatives, including Ada'a Dairy Cooperative, experience product loss during fasting periods. It was confirmed that half of the interviewed dairy cooperatives reduce the quantity of milk they collect during fasting seasons and also pay as low as 50% of the normal market price. In particular, the seasonal fluctuation in demand for dairy products was perceived to have more influence on urban and peri-urban fluid milk producers, who keep exotic and crossbred cattle. This is because processing milk from improved cattle into butter was perceived to be less profitable.[7]



7. According to experts' estimate 1 kg of butter is produced from about 20–22 kg of raw milk from exotic/crossbred cow, while it takes about 16.5 kg of milk from Fogera breed to produce 1 Kg of butter.





Source: Rainfall data from Ethiopian Meterological Agency.

Figure 1. *Rainfall and fasting periods in three IPMS PLWs.*

The survey results show poor dairy products quality and unhygienic handling are widespread, particularly when the products are sold through informal channel. The reasons identified include producers' and traders' low safety and quality consciousness,

poor packaging and transportation, and problems relating to feeding (such as milking cows grazing on pasture infested with invasive weeds, as reported in Tigray). Yet, no functional dairy products quality and safety regulation mechanism exists and market incentive is insufficient to encourage producers to adopt practices to ensure safe milk. Earlier dairy development interventions have focused entirely on improving the formal market, with little or no attention accorded to improving informal market and/or creating linkages between the two. Although informal channels are useful and seem to work better for poor producers and consumers (Ouma et al. 2007), it also raises serious public health concern.

4.3 Feed resource base

Natural pasture from communal grazing lands and crop residues have been the main sources of feed for dairy cattle, particularly in peri-urban and rural areas including pastoral/agropastoral systems. Land, water and feed resource-base are dwindling; and the competition for accessing whatever is available is fiercer today than ever before. Limited availability, seasonal variability and poor quality of feed are widely perceived as the most limiting factor in smallholder dairy production. The size and quality (species composition, vigour and palatability) of communal grazing lands have reportedly been substantially reduced over the past five years across all areas studied. The identified causes for 'the grazing land crisis' are many. While some causes are location specific, others such as urbanization and population growth are common (Table 4).

According to the interviewed experts and producers, deterioration in the feed resource-base has resulted in a very high seasonal variability in milk yield, biodiversity loss (indigenous breeds, tree and grass species), declining cattle population, and expansion of fodder market with rising fodder prices. On the other hand, the increasing fodder scarcity is stimulating producers' interest in on-farm fodder production and efficient crop residue utilization. Interviewed actors felt that while technological options are available for feed improvement, there are obvious strategic gaps relating to forage planting material multiplication and distribution systems, quality assurance and the coordination of feed development activities, and linking it to the dairy value chain.

Table 4. *Perceptions of causes and immediate outcomes of grazing lands crisis*

Causes	Immediate outcomes	Region/PLW
Expansion of urban centres to rural–urban fringe	Substantially reduced communal pasture area	Hawassa area
Expansion of coffee production in communal grazing areas	Reduced communal pasture area	Dale
Establishment of public facilities (FTC, school, health posts) on communal grazing areas	Reduced communal pasture area	Across PLWs, but repeatedly mentioned in Amhara Region
Redistribution and development of swampy areas for crop production (e.g. rice)	Loss of dry season and drought year grazing areas	Fogera and Alamata
Expansion of invasive weeds	Change in species composition and dominance of unpalatable species	Fogera, Alamata and Miesso
Resettlement programs	Reduced communal pasture area	Mostly mentioned in Amhara Region
Water logging and soil compaction	Change in species composition and reduction of palatable species	Alamata
Deforestation and timber harvesting	Loss of good grass and tree species in forest areas	Fogera highland
Seasonal drought	Feed shortage	Miesso and Tigray region

4.4 The wider policy environment

The present national development strategy of the country, known as Plan for Accelerated and Sustainable Development for Eradication of Poverty (PASDEP), emphasizes pro-poor, gender-responsive and sustainable commercialization of smallholder agriculture. PASDEP emphasizes diversification of production and export; creating conducive investment climate for rapid growth of the private sector investment in agriculture and agro-industry; improving governance through political, economic and administrative decentralization; and reducing vulnerability in drought-prone areas. Development of high-value commodities, value chain development and export-oriented investments have been identified as major tools for achieving smallholder agricultural commercialization (World Bank 2005). The development of commercial smallholder dairy production is thus consistent with the national agenda and aspirations.

The key measures implemented and with direct relevance to commercial smallholder dairy development encompassed:

- privatization of public dairy enterprises and promotion of pluralism in delivering livestock services
- increasing public investment in roads, telecommunication, rural electrification, and modern ICTs

- restructuring and decentralization of the management of public research and extension systems
- increased public investment in knowledge, physical, information and communication infrastructures to modernize and promote demand-driven and participatory agricultural research and extension
- massive resource allocation for food security and reduction of vulnerability in drought-prone areas
- supporting voluntarily established cooperatives and unions and
- reforms to increase access to rural finance.

As summarized in Table 5, the increasing public investment in knowledge infrastructure and human capital development, rural roads, and information and communication technology (ICT) were perceived as gradually creating the necessary fundamentals for the dairy subsector take-off.

Table 5. *Summary of policy-related changes and their perceived immediate outcomes*

Relevant changes	Immediate outcomes	Remark
Deployment of three DAs to each FTC, one specialized in livestock production	Improved focus on livestock extension	Livestock extension has remained weak, lack of adequate skills and resources
Improved rural roads	Improved access to market	
Deployment of more livestock health assistants	Increased coverage of livestock health service	Veterinary drugs not available most often
Regional liquid nitrogen producing plants	Increased availability of AI inputs	
More AI technicians trained in their region and deployed	Increased access to AI service	Producers prefer improved heifer to AI service
Access to wireless telephone service	Improved communication between DAs and WoARD	Specially important during disease outbreaks and to arrange services like AI
Aggressive promotion of dairy cooperatives	Increased milk selling, access to credit, processing technology and training	Increased levels of income and saving, the latter mainly due to fortnightly or monthly lump sum payment
Limited rural electrification	Encouraged processing	
More rural financial institutions	Improved access to credit	Loan products rarely suitable for dairy development

5 Dairy and forage innovation systems

In this section, a diagnostic assessment of Ethiopian DFIS is presented and discussed. This section explores key innovation systems actors, their roles and pattern of interaction; incentives, habits and practices influencing learning, interacting and innovation; coordination mechanisms; and policy and strategies for smallholder dairy development. Figure 2 depicts a stylized DFIS in the PLWs/regions studied.

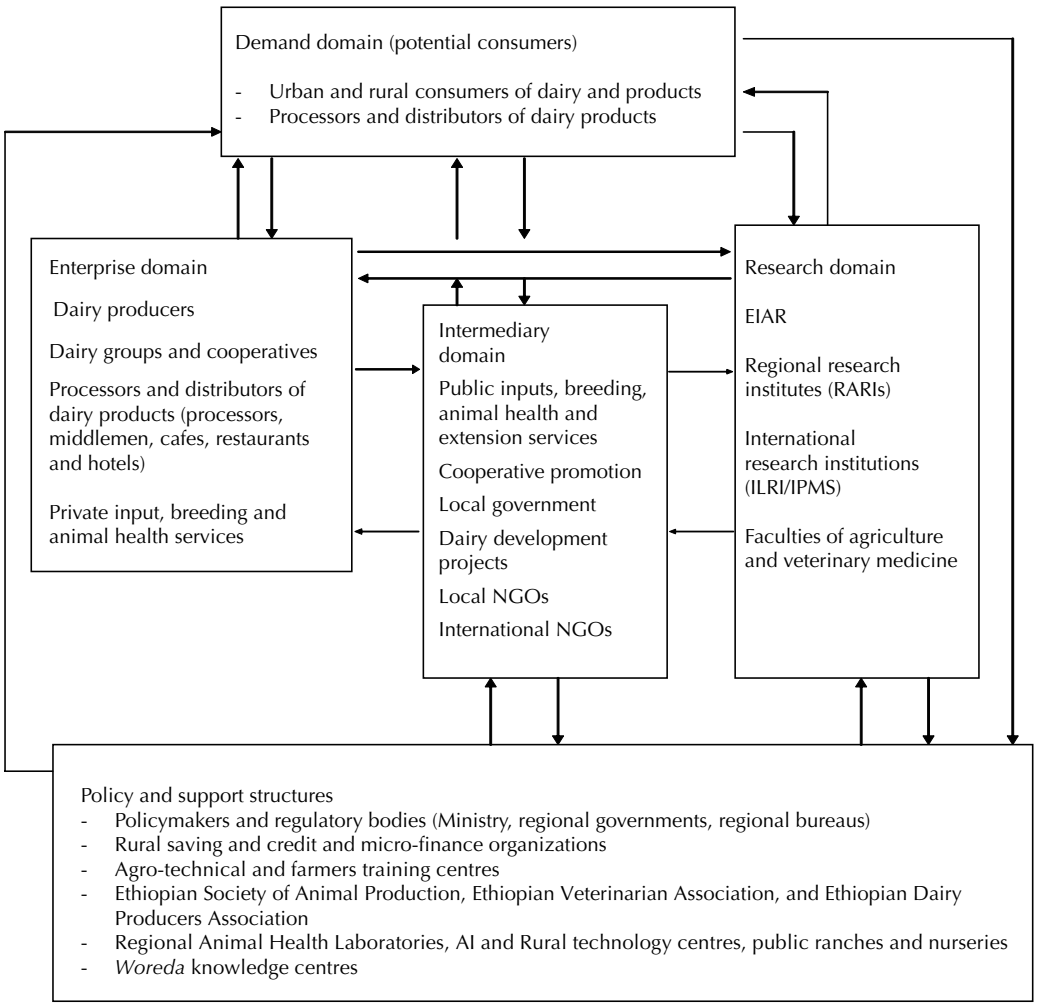


Figure 2. *A stylized dairy and forage innovation systems (regional/PLW)[8] level.*

8. Figure 2 shows generic dairy and forage innovation systems. The innovation systems can be different for different PLWs and for fluid milk system and butter system.

5.1 Actors and their roles

There are many and diverse public, private and civil society actors engaged in forage and dairy development; with a huge diversity across PLWs. Public actors are dominant, playing a wide range of roles. Following Hall (2006), the relevant actors have been categorized into six, viz, (1) enterprise domain—actors using codified knowledge and producing mainly tacit[9] knowledge; (2) research domain—actors producing codified knowledge; (3) intermediary domain—actors playing intermediation roles; (4) demand domain—consumers of goods and services; (5) policy domain; and (6) supporting structures. A brief description and discussion of roles and performance of the different categories of actors are presented in the following subsections.

5.1.1 Enterprise domain

The enterprise domain (Annex 2) encompasses small and large urban and rural dairy producers, individuals and groups who are engaged in milk collection, processing and marketing, and private input supply and animal health services.

Service provision by private actors is rather limited in scope and space, except for veterinary drug retailing across the PLWs. The only exception is Ada'a Liben, the PLW with a relatively commercialized dairy systems, due to its proximity to Addis Ababa, the national capital and the biggest market in the country. In Ada'a Liben, private nurseries, breeding and animal health services exist; and urban and peri-urban dairy producers could purchase dairy feed from factories and licensed concentrate feed suppliers. In the remaining PLWs, grass and crop residues are purchased from local market; and concentrate dairy feeds are available only in regional towns. IPMS, NGOs, WoARD have been promoting private provision of AI (Ada'a Liben and Bure) and bull service (Ada'a Liben, Alamata and Fogera), animal health service through paravets (Miesso), and in Alaba through Community Animal Health Workers (CAHW), private rural veterinary drug shop (Miesso), nursery (Alaba) and urea molasses block supply (Alaba and Miesso). But these initiatives are at an experimental stage. According to private service providers, increasing demand for private input and animal health service provision is evident due to improved dairy management, increasing income from dairying, and the recent introduction of improved or crossbred dairy cattle to some areas (e.g. Alaba).

9. Tacit knowledge (as opposed to formal or explicit knowledge) is knowledge that cannot be transferred to another person as a result of it being written down or verbalized. Tacit knowledge is not easily shared. Effective transfer of tacit knowledge generally requires extensive personal contact and trust. Tacit knowledge consists often of habits and culture that we do not recognize in ourselves.

Nonetheless, it is widely perceived that the development of private service provision has been constrained by lack of knowledge, resource and bureaucratic hurdles. Private providers frequently mentioned the difficulties in obtaining land/building, credit, and license. The interviewed veterinary drug retailers mentioned that they started their business with own saving, through joint venture, and with financial support/loan mobilized from families and close relatives. A professional license from RBARD and a trade license from Bureau of Trade and Industry are needed to enter private animal health service provision. Further, the seasonal nature of demand for inputs and animal health service, illegal trade and ineffective control mechanism, and capital limitations were identified as important challenges for the viability and expansion of private service provision.

On the other hand, smallholder dairy producers who used private service had expressed concerns regarding the quality of private input (planting material, concentrate dairy feed, veterinary drug etc.) and animal health services; the problem attributed partly to weak public regulation and/or enforcement mechanisms and partly to profit-orientation of private service.

5.1.2 Research domain

Table 6 presents the main public dairy and forage research actors in the PLWs. Ada'a Liben and Alamata PLWs house research centres, the other PLWs are served by the nearby regional and/or national research establishment. Faculties of Agriculture and Veterinary Medicine have important roles, particularly through graduate research, across PLWs. ILRI is the major actor and source of knowledge and technology, particularly in forage development.

Evidence shows national dairy research systems have generated useful technology, knowledge and information over the past decades, particularly in areas such as genetic improvement, fodder and feeds development, nutrition and feeding strategy, animal health and vaccine, and milk handling and processing technology (Azage et al. 2006). However, this has had limited impact on the development of smallholder dairy in the country. Historically, non-technical issues have received little attention by the national dairy and feed research.

An inventory of the dairy and forage-related research activities of the different research centres revealed that research continues to focus on technical issues. However, there are encouraging initiatives. These are F1 crossbred evaluation together with feeding, health, processing and marketing package through farmer research groups (FRGs) by Adami Tulu Agricultural Research Center (ATARC) with financial and technical support

of JICA; on-farm participatory evaluation of urea molasses treatments of straw by Debre Zeit Agricultural Research Center (DZ-ARC); and the selection and improvement of indigenous cattle breeds by Andassa Livestock Research Centre with financial and technical assistance of IPMS.

Table 6. *Roles of public research in PLWs*

Research actors	PLW	Roles of research actors
National Veterinary Institute	Ada'a Liben/ national	Vaccine production
Faculty of Veterinary Medicine/ AAU	Ada'a Liben	Animal Health Research
Ethiopian Biodiversity Institute	Ada'a Liben	Forage seed conservation
Melkassa ARC	National	Milk processing equipment
Debre Zeit ARC	Ada'a Liben	Forage development, straw treatment and on-farm demonstration of crossbred heifer
Adami Tulu ARC	Miesso	Breed, forage and milk processing technology demonstration
Werer ARC	Miesso	On-farm improved forage demonstration
No active research actor locally	Dale	Extracting information during survey
No active research actor locally	Alaba	Extracting information during survey
Andassa livestock RC	Fogera	On-farm demonstration of dairy technology
Andassa livestock RC	Bure	On-farm demonstration of improved forage
Bahir Dar Agromechanization Research Centre	Fogera	Adaptive research and promotion of milk processing equipment
Alamata ARC	Alamata	Demonstration of urea treatment
		Forage seeds distribution
ILRI	National	Dairy and forage research, pro-poor livestock policy and development
IPMS	All PLWs	Value chain and innovation systems analysis, technology adoption, gender, building national research capacity, financial and technical support to innovative research by public research and higher learning institutions' staff and graduate students
BOAM (SNV)		Dairy value chain analysis, private sector development
SDDP (Land O'Lakes)		Private sector development and dairy development policy and strategy

5.1.3 Intermediary domain

There are a large number of diverse intermediary organizations across the PLWs, but public actors are dominant (Annex 3). WoARD coordinates the provision of a wide range of production inputs, extension, marketing, livestock health and regulatory services. However, public extension system has been criticized for neglecting the demand side

of the commercialization process (Berhanu et al. 2006); failure to empower its rural clientele (World Bank 2005); less effective and inefficient AI service (Azage et al. 2006); and limited activities and coverage of dairy extension. Only 133,000 households (about 1% of the total livestock keepers) had participated in livestock extension package; with about a quarter of them in dairy development package (CSA 2008).

It is perceived by respondents that lack of actionable strategy, appropriate approaches, adequate ability, and limited connectivity to relevant sources of knowledge constrain the WoARD/RBARD from effectively performing the expected roles and implementing the wider policy agenda (poverty, gender, market-orientation, participation and partnership).

Dairy cooperatives are important intermediaries in the PLWs. The survey indicates that in most of the cases they have stimulated the culture of milk selling and have created access to markets for the producers though not necessarily increased their bargaining power. Cooperative members reported increased income and saving as a result of collective marketing. The cooperatives have also helped the members to access external assistance, and acquire improved technical and business skills related to commercial smallholder dairying.

The cooperatives appear to have focused more on processing and marketing activities (Table 7). Ada'a Liben is the only cooperative providing inputs and livestock health service to its members; and milk collection service to non-members through its satellite collection centres. Generally speaking, the contribution of dairy cooperatives has been limited by excessive focus on immediate benefits and high reliance on supply-driven external support and less business orientation; often member-focused in service delivery and limited non-market services; and poor organizational quality. Dairy cooperatives are not federated and therefore lack channels to effectively articulate members' demand for research and service, and influence policy and policymaking process.

Critical gaps in the previous dairy development interventions are being fulfilled by externally supported projects. Particularly, IPMS, BOAM and ESDDP projects have been championing private sector development to support milk value chain, and sponsoring multi-stakeholder platforms for learning and innovation.

Organization for the Rehabilitation and Development of Amhara (ORDA) and Relief Society of Tigray (REST) are the largest and progressive local NGOs involved in dairy and forage development. The other important NGOs are SOS-Sahel (Alamata), World Vision (Atsbi-Wemberta), Mercy Corps and International Rescue Committee (Miesso), LVIA

and SG–2000 (Alaba), Ethio Wetlands and Natural Resource Society (Fogera), Jerusalem Children's Development Organization (Ada'a Liben and Fogera) and Wash (Bure).

Table 7. *Dairy cooperatives activities and services*

Dairy groups/co-operatives	PLWs	Processing	Quality control	Other services to members	Serve non-members	Reduce collection during fasting
Ada'a Dairy Co-operative	Ada'a Liben	Yes	Yes	Yes	Yes	Yes
Dairy Group in Miesso	Miesso	No	Indigenous method	No	Open membership	No
Abosto Dairy Cooperative	Dale	No	Yes	No	No	Yes
Yichalal Behiberet	Dale	Yes	Yes	No	Yes	Yes
Dehansit Dairy Cooperative	Fogera	Yes	Yes	No	No	Yes
Yabibal Dairy Cooperative	Fogera	Yes	No	No	No	No
Damota Dairy Co-operative	Bure	Yes	Yes	No	No	Yes
Desta Dairy Co-operative	Alamata	Yes	Yes	No	No	Yes
Lemlemitu Wajja Dairy Cooperative	Alamata	Yes	Yes	No	No	No
Shewit Dairy Cooperative	Atsbi-Wemberta	Yes	Yes	No	No	Yes

NGOs tend to focus more on forage development and small ruminants fattening, rather than smallholder dairying owing to relatively long gestation period of dairy enterprise. The perceived limitations of NGOs were limited staff and technical capabilities for effective implementation of integrated development activities; overlap with development activities and services of the public agencies; and limited efforts and/or ability for scaling out and up successful experiences.

5.1.4 Policy domain

MoARD provides policy and strategy support to RBARD. Regional council formulates regional policy (like cooperative legislation in Amhara Region); allocates budget for research and development activities; and provides political leadership to ensure effective implementation of activities in line with national and regional priorities. Bureaus of Trade and Industry issue investment permits and license private service providers. Bureaus of Finance and Economic Development regulate budget use by public organizations, and

coordinate activities of NGOs. Food Security Offices[10] coordinate dairy development in areas designated as food insecure, and engage in food transfer and productive safety-net programs. The National Bank of Ethiopia (NBE) is responsible for formulating and enforcing rural financial service regulations, and licensing rural financial service providers. Regional Bureaus of Health (RBH) currently have no role relating to dairy development. However, future involvement of the RBH is crucial in addressing public health concerns related to intensive and commercial smallholder dairy development.

5.1.5 Support services

The various actors involved in providing support services are listed in Annex 4. Support services encompass rural finance, and knowledge and physical infrastructure. Regional government affiliated saving and credit organizations, NGO-affiliated micro-finance organizations and Cooperative Bank of Oromia (CBO) are the major rural financial service providers for smallholder dairy development in the PLWs. Omo Micro Finance (OMF) provides service in both Alaba and Dale PLWs, and Sidama Micro-Finance operates only in Dale. CBO, Oromia Credit and Saving Share Company (OCSSC) and Gasha Micro-Finance are key financial service providers in Ada'a Liben and Miesso. Amhara Credit and Saving Institution (ACSI) and Dedebit Credit and Saving Institution (DCSI) are the most experienced, cover larger numbers of clients and have larger turnover.

Like NGOs, rural financial organizations focus more on small and large ruminants fattening. While livestock development accounts for about 20% of agricultural loan portfolio of ACSI, fattening and small ruminants production take the lion's share. However, DCSI provides up to Ethiopian birr (ETB)[11] 5000 for smallholder dairying as medium term loan (4 years). Limited integration of rural financial services with dairy development and extension is the rule, than exception, in almost all PLWs. On the other hand, almost all dairy cooperatives had received credit and grants in cash or in kind mainly for processing equipment;[12] and credit for livestock purchase was given by Food Security Offices to producers engaged in productive safety net.

Public nurseries and ranches are crucial for multiplication and distribution of planting material and improved heifers. However, public nurseries are uncoordinated and lack adequate capacity to produce the type and quality of forage planting materials

10. Food Security is an office accountable to RBARD in some regions and a department under RBARD in others; and it is organized as a department in some PLWs and as a desk/team in other PLWs.

11. On 25 February 2010, USD 1 = ETB 13.3458.

12. From regional/*woreda* administration, Food Security/Cooperative Offices/Departments.

demanded. Ethiopian Seed Enterprise and the private sector did not show interest in forage seeds/cutting production and distribution owing to widespread perception of financial non-viability of the activity due to the market distortions resulting from distribution of forage seed/planting material for free or at a highly subsidized price by some GOs and NGOs. Similarly, despite preference of producers for improved heifer to AI, improved heifer multiplication and distribution activities are constrained by lack of enabling policy and adequate capacity.

5.2 Interactive relationships

All innovation systems actors have important roles, valid competencies, capacities and contributions. The actors and their roles are dynamic and could change based on how situations evolve. For example, the public sector role in input supply and service delivery is expected to be gradually taken up by the private sector. At the same time the role of the public sector may increase for regulatory and knowledge management functions. Understanding comparative advantages of actors, with respect to competencies they currently possess to perform their roles and to contribute to collective learning and innovation is useful (Hall et al. 2006). The actors could play complementary roles, and could benefit from each others' knowledge-base, resources and social capital. Such information could also highlight crucial areas of focus for innovation capacity strengthening activities. The current analysis confirms that there are indeed opportunities for the actors to complement each other and benefit provided conscious and effective interaction and knowledge sharing practices exist (Annex 5).

- Bureaus/WoARDs have strong technical capacity, grassroots presence and political capital.
- Public research has organizational structure capable of serving various agro-ecologies, is relatively better connected to crucial knowledge sources and is more willing and flexible to take risks.
- NGOs have strong poverty and gender focus, strong experience in facilitating participatory development, relatively better poised to mobilize technical and resource support through networking and linkages, and have structural and financial flexibilities for experimenting with service delivery innovations.
- Rural financial organizations have strong poverty and gender focus, active engagement with local administrative structures, flexibility for experimenting with alternative structural and institutional arrangements to expand their coverage and reach disfranchised groups.
- Dairy cooperatives play a crucial role in facilitating access to external technical and material support, and reduction of transaction costs for smallholder dairy producers' participation in input and output markets.
- Private services providers have incentive to be more responsive and timely.

- Development projects have higher access to both domestic and external knowledge bases, have structural and financial flexibility for learning and innovation and play a unique role in bringing together multiple stakeholders and facilitating platforms.

5.2.1 Pattern of interaction

Figure 3 shows existing general pattern of interactive relationships between the key actor types.

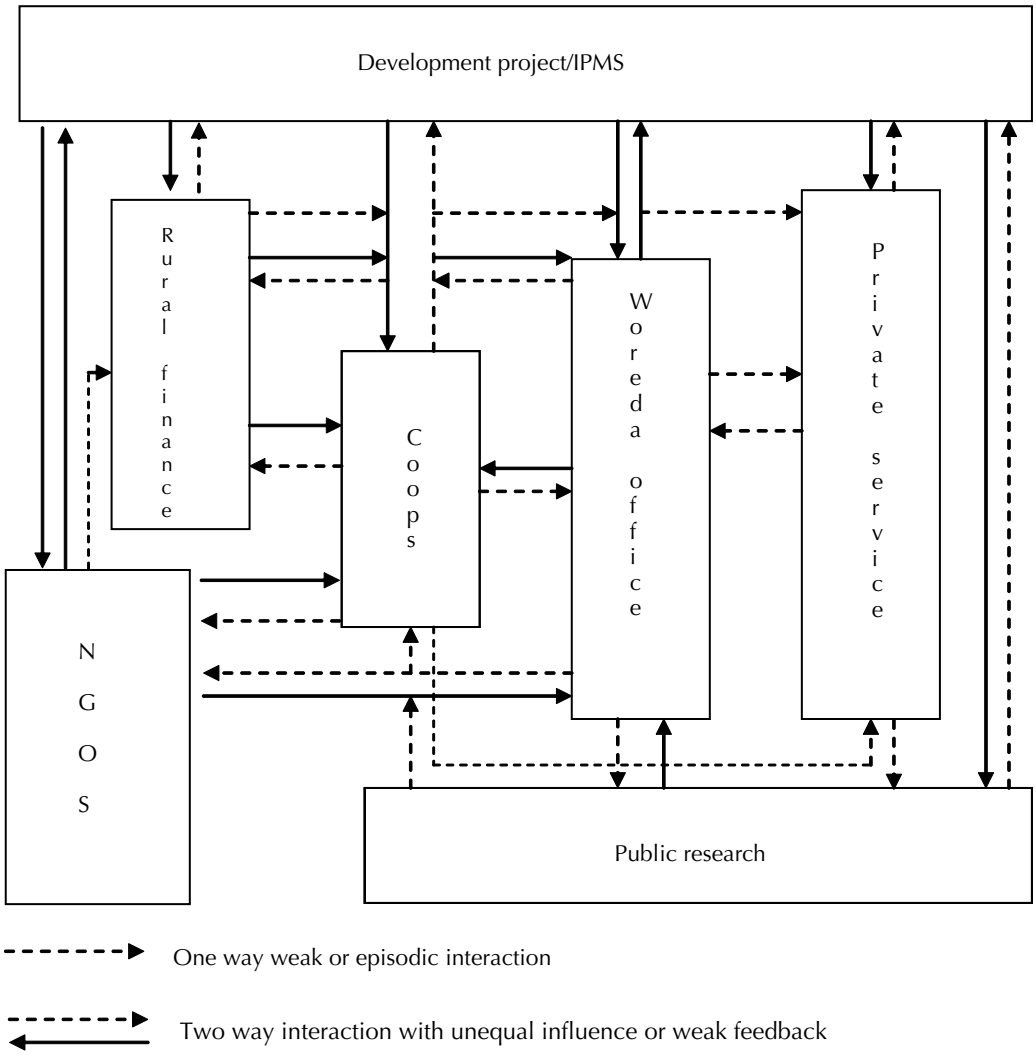


Figure 3. *Interaction between key actors in dairy and forage innovation systems.*

Except for Ada'a Dairy Cooperative, no meaningful linkages for knowledge sharing have been observed or reported with research in the remaining PLWs. It also happens to be the only cooperative with formal market contract with a private processor (Shola), and formal contract with private service providers for vaccination service to its members. Rural finance organizations, public extension, dairy development projects and NGOs have reasonably good interactions with dairy cooperatives.

Private service providers have limited interaction with research, mainly for acquiring inputs (improved forage planting material, heifers etc.). But generally the research system does not have adequate capacity to provide the quantities of improved inputs required. Private service providers initiated by regional bureaus or *woreda* offices in collaboration with projects or NGOs such as paravets and CAHW have strong knowledge linkage with extension, or are seen as part of the public service, but reported no meaningful knowledge linkages with research. The linkage of autonomously emerging private services (private veterinary drug retailers and fodder/feed suppliers) with regional bureaus or *woreda* offices is often limited to administrative (licensing) and regulatory (policing) issues. For example, veterinary drug importers in Addis Ababa were mentioned by drug retailers as their only sources of knowledge and information; and RBARD/WoARD was mentioned only once as an important source of knowledge and information.

Private service providers are rarely seen as important clients by rural financial service providers. However, reasonable knowledge and resource linkages exist between projects and private services; and recognizing the gap, IPMS has been providing credit support and also conducting research on ways of strengthening the private sector role in services provision.

Limited and *ad hoc* knowledge linkages were reported between NGOs and the public research (e.g. researchers as resource persons for training, participation in workshops, requests for improved inputs). While NGOs are proactive and often interact with public extension, the intensity and quality of interaction varies across PLWs, and more often is not trust-based. The interaction of NGOs with private service providers is usually absent. One exception is the partnership between an Italian NGO (LVIA), IPMS and Alaba *woreda* offices for promoting CAHW in Alaba PLW; and similarly ORDA is working in partnership with Amhara Region BoARD to promote private forage seeds and AI service provision.

The development projects implement their activities mostly through the existing public organizations, and to a certain extent, in collaboration with NGOs. Whilst these intermediaries interact with each other occasionally, the extent to which they are engaged in collective experiential learning and the facilitation of scaling out/up successful experiences is debatable.

More often than not, various actors have different and even conflicting motives that drive the interactions (Table 8). Whilst one partner initiates an interactive relationship for facilitating joint experiential learning and innovation, the other views the interaction as a means of accessing additional resources for routine organizational activities. This difference in motives coupled with lack of shared vision and limited communication has in many instances weakened interaction. This, in turn, can gradually lead to erosion of trust-based relationships. Hence, there is need for attitudinal change both in GOs and NGOs and building trust among the partners.

Table 8. *Misunderstanding leads to mistrust and tension*

NGOs perception of GOs	GOs perception of NGOs
Activity-oriented; not interested in knowledge sharing	Not willing to openly share their experience
Try to do many things at a time rather than prioritizing based on evidence; have no time for learning and sharing	Do not want to consult the concerned offices; contact experts only when they face technical problems during implementation
Fail to appreciate that the role of NGOs is 'gap filling'; not to replace them or give them everything they need	Less transparent and prefer to control budget alone
Do not appreciate the efforts of NGOs to stimulate the development of sustainable input systems	Not willing to provide resources to buy and distribute crossbred heifer and other inputs the producers need

5.2.2 Incentives, habits and practices

Established attitudes, habits and reward system could make taking on new roles, and responding to the needs of new clients as well as changing needs of traditional clients by public and non-public actors a daunting task. This section highlights few examples, though not generalizeable, captured during the fieldwork regarding the roles of incentives, habits and practices in influencing pattern of intra- and inter-organizational interactions.

Organizational culture and processes conditioning intra-organizational interaction

Evidence provided in Table 9 shows the role of organizational structure, culture, processes, and the prevailing performance appraisal and reward systems in reinforcing independence, rather than interdependence within WoARD.

Tradition and incentives influencing the responsiveness of research to societal needs

Some university faculties of agriculture with livestock sciences stream have retained the tradition of undertaking scientific research. According to a group of respondents, *'our role is generating knowledge to be communicated to scientific communities through*

publishing articles in peer-reviewed journals.' This is done with the presumption that 'someone else' has to take the responsibility for communication of the knowledge generated to the end users/clients. Knowledge generated by faculties of Institutes of Higher Education (IHE) and research centres are often not communicated in useful and accessible manner to livestock keepers (Azage et al. 2006). Besides, personal academic interest often takes precedence while selecting topics over the relevance of research projects to solving priority needs of farming communities (Belay 2007). This has been reinforced by incentive system; which until recently has been solely based on the number of peer-reviewed publications. In recent years, IHE are under immense pressure to make tangible contributions to national development agenda for rural development.

Table 9. *Causes of weak intra-organizational interaction (perception of WoARD experts)*

Causes of poor interaction	PLWs	Rank based on frequency
Organizational structure		Third
Frequent restructuring	Alamata, Fogera	
Staff turnover	Miesso, Fogera	
Individual performance-based evaluation	Across PLWs	
Inadequate incentives	Atsbi-Wemberta	
Program and process management		First
Top–down planning	Across PLWs, except for Miesso and Dale	
No internal mechanisms for experiential learning and sharing	Across PLWs	
Limited opportunity for cross-divisional interaction through social event, joint training, platform for discussing shared mission etc.	Fogera	
Leadership		Fifth
No strategic leadership	Ada'a Liben	
No multidisciplinary thinking	Fogera	
Organizational culture (habits and tradition)		Second
Mandate perceived to be unrelated	Alamata and Fogera	
Preference for working independently	Across, except for Miesso and Dale	
Lack of awareness of teamwork benefit	Ada'a Liben, Alaba, Fogera, Bure	
Lack of experience in joint and participatory planning	Ada'a Liben, Fogera	
Resource and logistic		Fourth
No resources allocated for joint activities	Alaba, Dale	
Logistical constraints (vehicle and per diem) for joint field visits	Alaba, Dale	

The head of a regional cooperative agency and division head of an NGO in response to a question about their interaction with dairy research said, *'interaction for what purpose?'* Further discussion revealed that it is felt that dairy research has little to offer,

except for some limited improved inputs, to the public and non-public actors who more often grapple with non-technical impediments to achieving market-oriented dairy development. The fact that technical/technological innovation more often than not requires concomitant socio-organizational innovations received little or no attention by dairy research.

However, there are encouraging developments in the form of moving away from the conventional disciplinary, supply-driven research and technology demonstration approach to commodity-based (ARARI and TARI), interdisciplinary (SARI) and farmer research group (ORARI) approaches. IHE have also recognized the need for re-orienting their research to address pressing societal needs. *'AU[13] took a bold measure to recognize and thus use locally oriented research results for promotion to the next higher academic rank. Currently, this criterion is incorporated in the promotion guidelines of all IHE in the country.'* (Belay 2007, 15).

Less responsive attitudes and practices lead to weak interaction of public research with other public/non-public development actors

Smallholder dairy producers are just one, among many key clients for commercial dairy development. Small-scale processors and distributors of dairy products need to acquire the needed technological, entrepreneurial and institutional capacities to succeed in a competitive market. Private support services need knowledge of different kind to provide efficient support for the commercialization of dairy systems. Yet, research may not seriously consider these actors as its key clients. Even where it does, it usually has neither the required organizational structure nor the necessary skills and experience mix to facilitate the articulation of private actors' knowledge needs and cater for the needs of these non-traditional clients.

Failure to reconfigure incentive, habits and practices to changing context makes public extension less relevant to other actors

Public extension has a long tradition of working with subsistence dairy producers; and it has been aggressively promoting productivity-enhancing dairy technology in a top–down fashion; with no or little attention to marketing, institutional and policy constraints. A group of experts, during the interviews, underlined that there was low level of understanding of market and market orientation concepts among experts due to traditional bias of public extension system.

13. AU, Alemaya University (the current Haramaya University).

Further, public extension system has not yet reconfigured itself in line with the emergence of new actors and increasing need for innovations of different nature, both by its conventional and new clients. A group of experts at RBARD confirmed during interviews that *'neither the experts nor the bureau seriously consider the private actors as stakeholders, who deserve as much attention as smallholder dairy producers.'*

On the other hand, private actors do not appreciate the significance of being part of knowledge networks to improve their response capacity. They did not mention knowledge links among the new links they would like to establish. Rather they would like to establish linkages with other professionals for joint ventures, financial institutions to access credit, NGOs to work on animal health awareness creation and veterinary drug importing companies.

Habits and incentive system discourage actors to take on new roles

A public input agency, accountable to RBARD, has been established recently in a region to take over the responsibility from livestock development department for multiplying/ purchasing, distributing and monitoring the use of inputs like crossbred heifers, bulls, semen and liquid nitrogen. The arrangement was intended to free the latter from input provision so that it would focus on extension and other core activities. Yet, the livestock development department had been reluctant to give up its traditional role of input supply, leading to unwarranted competition and duplication of efforts. Similar problem was reported between the recently established agricultural marketing agency, supposed to takeover the facilitation of credit and market for cooperatives, and cooperative agency of a RBARD. Further examination indicated that the prevailing incentive and reward system which is output rather than outcome-oriented might have been the reason behind such a behaviour. Linkage facilitation and knowledge brokerage activities apparently have no tangible or easily measurable outputs that might be rewarded.

5.3 Innovation systems coordination

As the preceding section clearly indicates, actors engaged in dairy and forage development are many and heterogeneous. There has been a continuous 'pouring in' of resources by multilateral and bilateral donors, directly through projects and NGOs, and indirectly, through food security and productive safety net programs. Increasing public investment is being made for infrastructural development, human capacity development, dairy research and extension.

Both public and non-public research and development actors rated the coordination as being poor. Factors such as unfavourable organizational culture and structure; inadequate

incentives for inter-organization collaboration; the lack of dairy interest groups/lobbies with enough clout to demand services and command accountability; lack of effective structural coordination mechanisms; and other procedural issues relating to adapting through systematic collective experiential learning were identified as causes for poor coordination. Important observations were made by the researchers with regard to causes and effects of coordination failure in the dairy and forage innovation systems.

In response to cattle feed shortage, public and NGO actors are promoting on-farm fodder production. The efforts are, however, diffused and uncoordinated due to the lack of coordination strategy and corresponding organizational and institutional arrangements. There is no well established national system for evaluating and releasing improved forage crops developed by research centres.

Several innovative activities are being experimented with at grassroots level by multiple actors across the regions. Innovations relating to input and animal health service delivery in the PLWs are summarized in Table 10.

Table 10. *Service delivery innovations*

Service delivery innovation	PLWs	Partners
Private commercial forage seed supply	Miesso	IPMS, WoARD
Private nursery and feed shop	Alaba	IPMS, WoARD
Cooperative feed processing	Ada'a Liben	External support
Private balanced concentrate feed processing and distribution	Ada'a Liben	Owner, knowledge linkage with Koudje and Privimi (Hollad) and KOF (Denmark) companies
Private urea molasses block shop	Alaba and Ada'a	IPMS, WoARD
Private rural veterinary drug shop	Miesso	IPMS, WoARD
Public mobile clinic	Amhara	ORDA, BOARD
Private mobile clinic	Ada'a Liben	Owner
Community animal health workers	Alaba	LVIA, IPMS, WoARD
Private/community bull service	Ada'a Liben	IPMS, WoARD
Cooperative AI service	Ada'a Liben	Ada'a Cooperative
Farmer AI technician	Bure and Fogera	WoARD, RBARD

The other innovative initiatives in different PLWs comprise:

i. technological innovations such as improved forage and crop residue treatment (across PLWs); promotion of indigenous Boran (Alaba), Begait (Alamata), Fogera (Fogera) and Barka (Amhara, Wollo) cattle breeds; milk quality control and processing by dairy cooperatives (Ada'a Liben, Alamata, Bure, Dale, Fogera); and balanced concentrate animal feed processing (Ada'a Liben);
ii. marketing innovation such as satellite milk collection centres (Ada'a Liben);

iii. organizational/managerial innovation such as the rehabilitation and management of communal grazing area (Alamata, Atsbi-Wemberta and Fogera);
iv. institutional innovations such as community-based contractual improved forage seed multiplication (Ada'a Liben and Fogera); milk sales contract with private processors (Ada'a Liben); Farmer Research Group (Adami Tulu Research Center); on-farm farmer participatory research (DZ-ARC); participatory commodity development with value chain approach (IPMS); and
v. rural financial service delivery innovations such as innovative repayment schedule (DCSI), satellite branch (Gasha Microfinance), in-built life insurance for clients (OCSSC), bank and cooperative partnership for rural financial service delivery (CBO), and staff and branch specific performance-based incentives (ACSI).

Many actors and innovation activities seem to be evolving, but functional mechanisms rarely exist for systematic experiential learning at organizational and systems levels; and for facilitating scaling out/up of successful experience to achieve wider impact and inform policymaking. In fact, efforts are underway by IPMS and the other dairy development projects to facilitate linkages and stimulate the development of functional multi-stakeholder platforms. The effectiveness of similar attempt by EIAR and RARIs to stimulate multi-stakeholders platforms has been constrained by institutional, structural and policy related factors (Teklu 2007); and are often cereal-biased with less attention to market-oriented development of smallholder dairy. An initiative is underway by BOAM-SNV to strengthen regional/national dairy platform and there is an on-going attempt at forming a dairy union.

To enhance coordination, creating an independent entity (e.g. dairy development corporation); bringing about attitudinal change to enhance inter-organizational collaboration; creating joint accountability mechanisms; and recognizing the importance of coordinating the innovation systems and allocating resources for coordination activities were suggested by respondents.

5.4 Subsector development policy and strategy

Given the challenges facing the dairy subsector in Ethiopia, government policy has a critical role in facilitating transformation of the prevailing smallholder dairy production systems to productive, sustainable, market-oriented dynamic systems. The roles of national and regional governments transcend beyond promulgating economic liberalization and increasing public investment in human capital, rural infrastructure and dairy research and extension which have laid the foundation for the subsector to take-off. Nonetheless, carefully thought-out, evidence-based, participatory and adaptive policymaking supported by systematic learning is indispensable if the multiple objectives of dairy development have to be effectively addressed.

Ethiopia has no specific livestock policy, but the rural development policy and strategy has some provisions indicating general directions. A Dairy Development Master Plan (DDMP) was formulated in 2002 to guide the subsector development and has been implemented in all regions. The DDMP highlights input and output targets, but does not provide a roadmap or guidelines and principles to inform actual policy implementation. On the other hand, whilst general guidelines and principles can be designed at national level, it is neither possible nor appropriate to design a master plan and implement throughout the country, or even a region. Local context should ultimately dictate the specific content of development plan (de Beer and Marais 2005).

Stakeholders perceived the following as critical policy and institutional gaps/constraints:

- gaps in policy and strategies for livestock breeding, conservation and use, live animal export, and grazing land policy/implementation;
- gaps in regulation and assurance of the quality of inputs, services and products such as forage planting materials, feed, veterinary drug and improved heifer; AI and animal health service provision; dairy products quality and safety; and reinforcement mechanisms for controlling illegal veterinary drug importation and distribution; and
- some practices discouraging the expansion of private provision of animal production input and animal health service such as unfair competition (subsidy and free distribution of inputs), bureaucratic hurdles, access to credit, and private service disconnect from sources of relevant knowledge and information.

6 Conclusion and recommended options

The study looked at the actor landscape, the efforts directed at dairy development and their outcomes through an innovation systems lens. The study concludes that unprecedented opportunities exist or are emerging for achieving productivity improvement and market-orientation in smallholder dairy systems. These are derived from: i) favourable national policy framework and increasing public investment in food security and safety net programs, agricultural R&D, rural roads, and in ICT infrastructural development; ii) the signs of improvement in demand for and prices of milk and milk products as well as the stimulation of milk selling culture with the increasing number of dairy cooperatives; iii) engagement of various actors along with public sector in smallholder dairy development through various pilot innovative initiatives; iv) emerging pluralist service delivery with gradual increase of the private sector involvement; and v) availability of technological options to address constraints relating to cattle feed, breeding, animal health and milk handling and processing.

However, there are daunting challenges especially on the demand side. These include such factors as high marketing costs, highly seasonal and low milk consumption habit, and safety and quality concerns. Limited marketable surplus, high seasonal variability of milk production, and unhygienic handling and poor quality are supply-side constraints. The other constraints are related to gaps in public capacity for regulation and quality assurance of input supply both by private and public sector; limited coordination among actors in addressing the development challenge; and limitations in policy, huge gap between policy and it's implementation, and providing an enabling environment for an effective functioning of the system.

In the following section, some institutional, organizational and policy options for moving smallholder dairy systems along a sustainable commercialization path are presented, along with possible entry points to enhance capabilities within the innovation systems to adapt and respond to dynamic context. Technological options are not addressed here as most previous research has done this exhaustively and this study shows that technology availability might not be the most limiting factor for smallholder dairy development in Ethiopia. It is recognized that access to technologies is a constraint and some of the options presented here address the same. Whilst some of the options have emerged from the current analysis and observations, other applicable options have been identified from successful experience with smallholder dairy development in Asia and Africa.

6.1 Options for addressing market constraints

Possible options for creating sustainable demand and economic incentives for smallholder dairy producers are as follows:

- Strengthening dairy producer groups/cooperatives, with special attention to enhancing business-orientation; and, where appropriate, linking them vertically to processors and input suppliers to reduce transaction costs, improve product safety and to encourage value addition along the entire supply chain.
- Strategically linking market-oriented smallholder dairy development intervention to informal markets through food security/food transfer programs and institutionalized school feeding programs incorporating locally produced milk and products. This has dual advantages: it creates sustainable demand for smallholder dairy producers and small-scale processor groups, whilst simultaneously addressing malnutrition among school children.

  Market led smallholder dairy development was strategically linked to food transfer/ aid programs (India) and school feeding programs (the Philippines, Thailand, and Mongolia) in Asia. In India, food aid/milk powder monetization program was found to be effective in encouraging local production and stimulating consumption. In the Philippines, government and community-sponsored institutionalized school milk programs supported smallholder dairy development (buying 40% of local milk production in certain areas) as well as generating long-term demand for locally produced milk and dairy products, while simultaneously addressing children malnutrition.

  The implementation of the option, however, calls for collaboration within RBARD (Food Security Office/Department, Agricultural Marketing and Cooperative Agencies/ Departments) and forging medium to long-term partnership between RBARD and development partners financing such programs (e.g. World Food Program in Miesso).
- Creating innovative linkages between urban-based cooperatives and peri-urban fluid milk producer groups, and, where feasible, to remote rural butter producer groups. In this regard, it is worth considering the possibility of scaling-out the concept of 'satellite collection centres' currently being promoted by Ada'a Dairy Cooperative and introduced a while ago in Selale area. Processing needs a boost in supply from milk producers in remote rural areas and helps to protect the latter from the seasonal demand fluctuations.
- Ensuring local milk quality and safety, developing properly packed and ready-to-drink milk and other culturally preferred products like yoghurt as well as promotional campaign by dairy cooperatives and processors to raise wider awareness of the health and nutritional benefits of regular consumption of milk. However, this would be applicable only to urban and peri-urban systems.

Ensuring local milk quality and safety, generic milk branding, and promotion of local milk as 'green milk' through campaign by processors' association in Mongolia had helped to re-build the confidence of urban consumers and to stimulate domestic milk consumption. Further, ready-to-drink processed and cultured products such as yoghurt, sweetened condensed milk (the Philippines, Sri Lanka, Thailand and Vietnam) had led to faster growth of demand for local products and had encouraged smallholders close to remunerative markets to go into value addition. With regard to product quality and safety, training and certifying traders in informal market and linking them with the formal market in Kenya and introduction of milk payments based on quality in some zones in the Philippines had boosted quality assurance.

- Of critical importance is the strengthening of WoARD-project/NGO (e.g. Land O'Lakes) partnership for building the capacity of experts and dairy cooperatives in milk safety and quality standards; and, where appropriate, for the training and certification of traders in the informal channel.

6.2 Options for enhancing effective functioning of service delivery systems

- To be competent, smallholder dairy producers need appropriate, affordable and easily accessible package of production technology, locally manufactured milk processing equipment and support services (FAO 2007). Most of these products and services can be provided in a cost-effective manner through small and medium private enterprises. The emergence of private sector as a strong player in service provision is constrained by bureaucratic hurdles and a perception that they are competitors. Even though the policy explicitly pledges support to private sector development, measures are not in place to ease or facilitate their entry. Public–private partnerships are very nascent in some cases or non-existent. Public sector needs to find mechanisms and strategies to encourage private sector involvement and provide them with a level playing field. It could support them by identifying and developing market for goods and services produced by private actors through, among others, contracting-out improved input multiplication, manufacturing of simple processing equipment and provision of public services like vaccination. Emergence of an effective pluralistic service delivery system can ensure access of smallholder dairy producers to appropriate and affordable production technologies and support services from the private sector, whilst allowing the public sector to gradually withdraw from service delivery and focus on regulatory function and quality assurance.

  However, private sector capacity needs (entrepreneurship, leadership and forming groups), market linkage, business development service, and access to knowledge, resources and infrastructure (Kurokawa et al. 2008) also have to be addressed. The capacity of public sector for taking on regulatory and quality assurance functions effectively needs to be strengthened alongside private sector development.

It is possible in Ethiopia to launch selective privatization of dairy production input supply and animal health service delivery in certain areas where private actors are available and where there is effective demand for the service (e.g. in Ada'a milkshed). In Kenya, for instance, livestock-dependent producers in arid and semi-arid areas receive public support for all clinical services. Producers in marginal localities in the fringes of the highland receive a mix of public and private service, whereas all clinical services are stipulated to be provided by private sector in intensive high potential areas where livestock keepers have effective demand for the service (Staal et al. 2008).

- Despite their limitations, dairy cooperatives still have a potential role to play to ensure cost-effectiveness in service delivery and insurance by providing/coordinating them and to facilitate linkages between producers, enterprises, R&D services and policymakers. In addition, there is a need to support the emerging dairy cooperatives and encouraging their federation, so that their capacity can be built and they can provide a strong voice in platforms and policy dialogues. In this regard, the initiative underway to establish Regional Dairy Cooperative Union with the support of SNV–BOAM is pertinent.
- Appropriate loan and other rural financial products need to be designed for supporting smallholder dairy and private service provision. This requires that the Agricultural Bureaus, w*oreda* offices, and cooperatives have to proactively engage with the rural financial organizations to support the design and delivery of such products.
- Knowledge and information are critical inputs for improving productivity and market success. However, the research and extension agencies fall short of providing relevant knowledge at the relevant time. This is mainly attributed to limitations in their capacity, operational resources and incentives; and weak linkages with each other and other actors. The Business Process Re-engineering (BPR) is an opportunity to revisit and revise the target-based reward systems, with no accountability for outcomes of the efforts. This is important to encourage focus on innovation and socio-economic outcomes, rather than technology generation and transfer alone. The research and extension systems should also widen their network to include private sector as their clients who require knowledge support. Another important complementary measure is creating incentive systems through leverage funds and competitive grants to encourage intervention-based public–private partnership for organizational and institutional innovations. Rural Capacity Building Project of MoARD may be a candidate to take the lead in implementing such schemes. The Dutch government is also encouraging private investment in dairy through a special program. Agricultural Marketing Agency at RBARD may forge partnership with actors like SNV–BOAM to develop the required competence and attitude within RBARD.

6.3 Options for creating an enabling environment

- The line departments are facing a formidable challenge in translating the general policy objectives into operational elements due to the lack of actionable strategy. Although the national DDMP was crucial for highlighting input and output targets, it had been inadequate in clarifying the road map and providing guidance for appropriate and coordinated policy implementation on the ground. Moreover, there is no functional strategy for addressing the critical problem of cattle feed and breed improvement in a coordinated and market-oriented fashion. This analysis suggests that it might be essential to have a national smallholder dairy development policy and strategy.

  Development of such a policy should be based on evidence and in consultation with key stakeholders, along with a carefully thought-out complementary strategy or action plan.[14] This is required, among other things, to setting priorities and striking balance between multiple objectives such as: increasing income, reducing poverty and enhancing competitiveness of the subsector; and harmonizing policies and regulations influencing the development of dairy subsector such as rural finance, live animal export, land use, licensing private provision of breeding and animal health service. Furthermore, national policy and strategy should provide guidelines and principles with respect to:
  - systematic spatial and social targeting of investment and development interventions through, among others, observations from household survey and GIS;
  - stimulating the development of milk value chain and ensuring successful participation by smallholder producers and others;
  - ensuring sustainable demand for milk and products, and enhancing return to smallholder dairying as an incentive to stimulate commercialization and innovation;
  - clarifying changing/new mandates and roles of public and non-public actors as well as collective responsibilities;
  - addressing market failure, facilitating private sector development and building the public sector capacity for regulatory functions and quality assurance;
  - in the light of changing priorities, context and needs—re-orienting the roles of innovation systems actors, organizational culture and processes; and developing incentive and accountability system to reinforce the culture of inter-organizational collaboration, innovation and impact-orientation; and
  - developing functional institutional arrangements for facilitating collective experiential learning and for scaling out and up successful experiences to achieve wider socio-economic impact and inform higher level policy.
- Experience shows that organized stakeholders are more likely to actively participate

14. One entry point is initiating facilitated platform to reflect on the existing DDMP and to discuss the need for developing policy or revising the DDMP. With respect to this, IPMS, BOAM and ESSDP-Land O'Lakes have overlapping interests, complementary expertise, and can thus forge strategic partnership.

in defining research challenges and in identifying and prioritizing innovation needs (Rajalahti et al. 2008). At present, the dairy cooperatives do not have enough clout to influence policy and the development actors. Similarly the private actors are often unorganized, and constrained by policy and limited access to knowledge and resources. It is important to provide platforms to give emerging producer organizations a voice to enable them influence policy, demand services and command accountability.

- Appropriately targeted investment and custom-made interventions, approaches and methods are required as the dairy production system in the country is highly diverse and complex. Institutionalizing decentralized planning and implementation of dairy development intervention, within national dairy development policy and strategy framework could be a way forward.

6.4 Options for enhanced knowledge and information sharing and learning

- Knowledge flows and learning form the bedrock of innovation. Productivity improvement can be achieved primarily through creative use of existing appropriate and profitable technological options, which should include local knowledge as well as knowledge from formal research and development actors in the country and beyond. What is crucial here is enhancing the ability of actors to access, adapt, creatively integrate and productively use knowledge of different types from different sources for practical problem solving. A strategy is required that could enable innovative exploitation of the opportunity created with the development of ICT infrastructure to enhance interaction, knowledge management and information provision. An important opportunity to be exploited is the Ethiopian Agricultural Portal, *Woreda* Knowledge Centres established by IPMS, and multiple initiatives to provide market information through mobile phones, billboards etc.
- A sticky challenge is the lack of knowledge sharing culture within and between organizations and actors. There is little evidence that practice, competencies, and incentive and accountability systems in the public organizations have been sufficiently reconfigured to the policy shift, the emergence of new actors and need for innovations of different nature. Conscious efforts need to be made to promote this, while acknowledging that this needs a mindset and behavioural change both at individual and organizational levels, the latter being more challenging and slow. The RALCs and WALCs established by IPMS provide an example of such initiatives which provide a platform for learning, inform planning based on lessons learnt, and mobilize joint action. This experience needs to be critically analysed and good principles drawn to scale out and up.

6.5 Options for enhanced inter-organizational coordination

Last, perhaps most important, requirement is ensuring articulated and coordinated effort by the dairy and forage innovation systems actors. There are important but weak linkages; and coordination failure is apparent. The options proposed in this paper need pilot testing and adaptation; and process driven approach to learning is needed for achieving incremental improvement. We suggest the following institutional options to improve system coordination and knowledge management.

- Creating/strengthening dairy platforms at w*oreda* and/or milkshed level, with representation of private actors and dairy groups/cooperatives:
  - for encouraging reflection and learning around shared interests, actions and experiences in diary value chain, and
  - for pilot testing and adaptation of organizational and institutional options.

Platforms at this level keep the expectations and plans realistic by making them relevant to the local context, make the process manageable, and to demonstrate impact, and thereby influence higher level policy.

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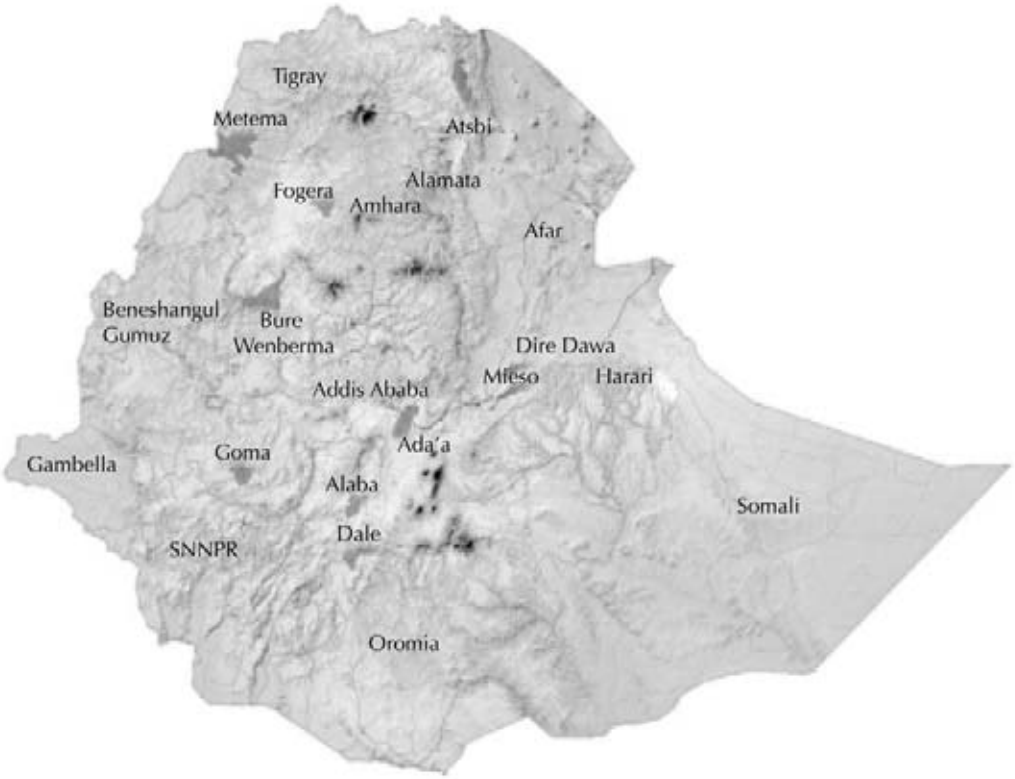
Annex 1 Map of PLWs



Annex 2 Enterprise domain

Roles	Actors
Private production and health services	
1. Feed • Forage seed/planting material • Concentrate feed processing/supply • Feed/fodder retailing • Fodder export	Private nursery Flour factory Private feed processors Ada'a Dairy Cooperative Private feed shops Smallholder fodder traders
2. Breeding services • AI service • Bull service • Heifer supply	Private AI technicians Private producers/groups
3. Animal health services • Veterinary drug supply • Vaccine production • Diagnostic and treatment • Routine treatment and vaccination	Veterinary drug importers National Veterinary Institute Veterinary drug retailers Private clinics Ada'a Dairy Cooperative Paravets/CAHW
Production, processing and marketing	
1. Dairy producers	Rural smallholder producers Urban smallholder producers Urban private large farms Yichalal dairy farm
2. Processors and distributors	Private processors Dairy cooperatives/women milk group Shops and supermarkets Mobile traders Retailers

Annex 3 Intermediary domain

Actors	Roles
1. Public • Cooperative agency • Marketing agency • Agricultural extension • Input agency • Micro and small enterprise development office • Women's Affairs Office • Food Security Office • Urban and rural administration	Dairy cooperative promotion and facilitating their legal organization Facilitation of credit and market for cooperatives Training, technology demonstration and linkage facilitation Multiplying/purchasing, distributing and monitoring input use Promoting urban dairy group for income generation Organizing and supporting women dairy group Finances dairy and forage technology promotion activities Facilitating access to land, infrastructure and services by dairy cooperatives
2. Development projects • IPMS • ESDDP • BOAM • NLDP	Improving productivity, value chain development, innovation capacity building and knowledge management Improving productivity and milk quality, and value chain development Building capacity of the private sector, networking, policy dialogue, and value chain development Strengthening capacity for public AI service provision, supporting forage development and group milk processing and marketing
3. NGOs • ORDA (local) • REST (local) • World Vision • SG–2000 • LVIA • International Rescue Committee	Improving animal health coverage and AI services, improved forage Improving feeding and husbandry practice, provision of dairy cattle, and promotion of group milk processing and marketing Forage development Crossbred heifer distribution Training and supporting of community animal health workers (CAHWs) Finance improved forage promotion
4. Multilateral supports • EU • WFP • FAO • World Bank	Finance forage development and crossbred heifer supply Budgetary support for irrigation and extension Finance forage multiplication and animal health
5. Dairy cooperative	Collective processing and marketing service, and facilitation of access to external supports by dairy cooperatives

Annex 4 Supporting structures

Actors	Roles
Rural finance	Rural financial services for urban and rural dairy producers and producer groups
– ACSI (Amhara Credit and Saving Institution)	
– DCSI (Dedebit Credit and Saving Institution)	
– OCSSC (Oromia Credit and Saving Share Company)	
– CBO (Cooperative Bank of Oromia)	
– Rural Fund (Southern Region)	
– OMF (Omo Microfinance	
– SMF (Sidama Microfinance)	
Knowledge infrastructure	
Woreda Knowledge Centre	Source of relevant knowledge and potential platform for knowledge sharing
ATVETs	Training DAs
FTCs	Farmers training and technology demonstration
AI training centre	Training AI technicians
ESAP (Ethiopian Society of Animal Production)	Knowledge sharing forum
EVA (Ethiopian Veterinary Association)	Knowledge sharing forum
EDPA (Ethiopian Dairy Producers Association)	Knowledge sharing and policy lobbying
RALC/WALC/Dairy Platform	Innovation systems coordination
Physical infrastructure	
Regional Animal Health Laboratory (RAHL)	Animal health diagnostic service
Regional AI Centre (RAIC)	Producing liquid nitrogen, training technicians
Rural Technology Centre (RTC)	Producing processing equipment
Ranches	Maintaining, improving and multiplying breeds
Public nursery	Multiplying improved forages and tree seedlings
Rural road and telecommunication service	Improving access to market and market information
Rural electrification	Power supply for storing and processing milk

Annex 5 Stakeholder perceptions of competencies of key actors

Actor category	Strengths	Limitations
Bureaus and WoARDs	Large number of experienced technical staff; strong structure that extends to grassroots level; improving basic infrastructure for training, technology multiplication, inputs supply and service delivery; political capital; and ability to attracting the attention of non-public actors due to its key roles and position	Capacity limitations with respect to implementation strategy, appropriate approaches and required abilities to implement pro-market, pro-poor, gender-sensitive and participatory development; managing partnership with non-public actors; and limited connectivity to diverse sources of knowledge
Public research	Agro-ecological based structure, improving technical capabilities in terms of staff and infrastructure for research; relatively better connectivity with diverse sources of knowledge; and relatively better willingness and structural flexibility to take risk for innovation	Capacity limitations with respect to operational strategy, appropriate approaches and abilities to address needs of disenfranchised groups, the private sector; less focus on non-technical impediment to dairy development such as market, innovation, organization and financing of service delivery and other institutional issues; and limited means and ineffective methods for communicating research results in organized, useful and easily accessible ways
NGOs	A strong poverty and gender focus in interventions, and participatory in approach; better capacity to mobilize resources and technical supports through networks and linkages; structural and financial flexibilities for approaches and service delivery innovations	Limited staff and technical capabilities for effective implementation of integrated development activities; pretty similar development activities and services with those of the public agencies; limited efforts and/or ability for scaling up and out successful experiences and thereby positively impact public organizations' habits and practices
Rural finance	A strong poverty and gender focus in services; actively engaging local structures and community representatives' in decision-making; flexible interest rate, and experimenting alternative institutional and structural arrangements in order to increase service coverage and reach disfranchised groups	Often less suitable credit service for rural smallholder dairy subsector, limited connectivity to diverse sources of knowledge, less integration of financial services with extension and development activities
Dairy cooperatives	Facilitation of access to external technical and material supports; reduction of transaction costs of participating in input and output market; encouragement of milk selling culture	Excessive focus on immediate benefits; member-focused services; high reliance on supply-driven external support; and often poor organizational quality and lack of integration
Private service providers	Provide producers alternative source of service, relatively more responsive in terms of timeliness and more efficient than public services	Services limited in scope and space; business-orientation than client-orientation; unorganized to influence policy; and disconnected from relevant sources of knowledge
Projects	Connected to diverse sources of knowledge; structural and financial flexibility to learn and innovate; relatively free from local politics	Less understanding of local context; and short duration

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